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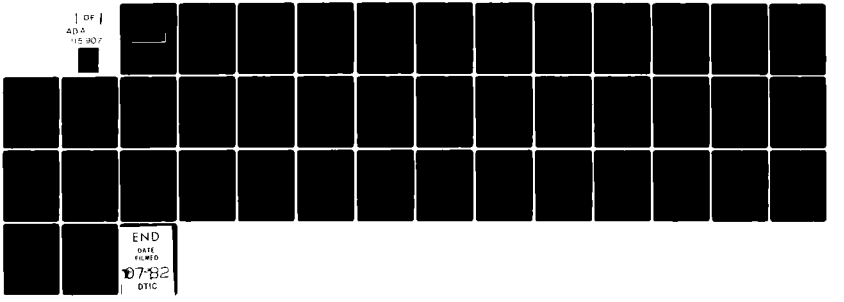

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report describes work done by the US Army Inventory Research Office during the period October 1980 - September 1981. Reports published during the period are listed, along with papers presented at professional meetings and notes on other professional activities.

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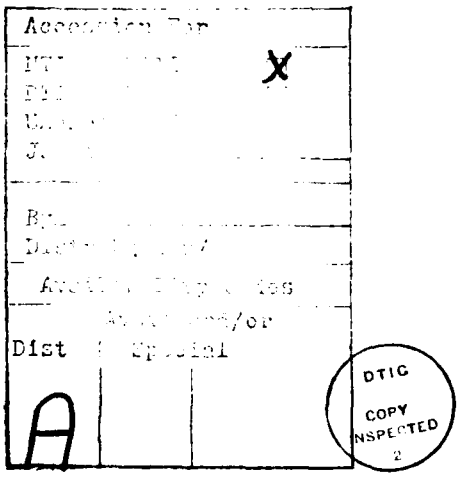

US ARMY INVENTORY RESEARCH OFFICE

OVERVIEW

This report describes IRO activities in FY1981. Annual Reports for previous years go back to FY1966.

The IRO organizationally became a part of the Army Materiel Systems Analysis Activity (AMSAA), Aberdeen, MD, during FY1981, although it remains physically in its location in the US Custom House, Philadelphia, PA. AMSAA assumed operational control of IRO on 1 February 1981, when DARCOM delegated to AMSAA responsibility for management of the DARCOM Systems Analysis activities. Full incorporation took place on 1 October 1981, when AMSAA took over administrative control as well. IRO is now a part of AMSAA's Field Liaison, Logistics and Readiness Division. The Army Procurement Research Office and Logistics Studies Office became a part of AMSAA at the same time; they remain physically located at Fort Lee, VA.

The IRO completed eight projects during the year. Three new ones were started and two are carried over into FY1982. In addition, ten, which were started prior to FY1981, have been carried over into FY1982.

Army readiness and sustainability in combat remained a prime area of effort in FY1981. The IRO was designated to coordinate all Combat Prescribed Load List/Authorized Stockage Lists (PLL/ASL) activities for AMSAA. This includes production of PLLs, combat damage requirements portions of ASLs (to be done at AMSAA), reliability failures requirements portions of ASLs, development of integrated combat damage/reliability failures ASL methodology (to be done jointly), data collection and data base management (to be done at AMSAA) and development of systems improvements. Work continued on improvement of computational methodology and production of Combat PLLs. While MRSA has taken over management of the PLL data base, IRO will continue to run the models for the foreseeable future. AMSAA has begun computation of combat damage requirements for pacing items of an Armored Division ASL. Data call specifications have been developed for ASL reliability failure requirements. It is expected that most of the PLLs and an Armored Division ASL for pacing items will be completed in FY1982.

DARCOM/DA approval was given to the AMSAA/IRO concept for the new system for computing War Reserve requirements. IRO chaired a series of working group meetings of Army, Navy, Air Force, Marine Corps and DLA personnel in developing a standard computational methodology to be used by all in the implementation of DoDI 4140.47, "Secondary Item War Reserve Requirements Development." ALMSA is developing the Functional Description/Requirements Description and full scale ADP system design is expected to begin at ALMSA in early FY1982. IRO work in FY1982 will concentrate on systems for contingency plans and sustainability analyses.

Plans for incorporating the Bare Bones War Reserves methodology into the SESAME model were carried to fruition during the year. Computer programs and user guides were completed and distributed in time for use in the current POM cycle. Enhancements were made to SESAME, including capability to handle non-vertical supply structures, and work was begun to provide capability to handle asymmetric support structures and non-stationarity. A further extension on

which work is well underway is capability to consider maintenance resources (test equipment, personnel) in the optimization scheme.

Meyer Kotkin, previously a summer student employee, joined the IRO staff in a full-time career position in November 1980. The staff remained otherwise unchanged.

US ARMY INVENTORY RESEARCH OFFICE
COMPLETED STUDY SUMMARY

TITLE: Design of a Prioritized Depot Scheduling System for Secondary Item Repair

IDENTIFICATION NUMBER:
IRO Project No. 255

REPORT: "Secondary Item Repair of Depot Reparables," Arthur Hutchison, IRO Final Report, November 1980, AD A097185.

SPONSOR: DARCOM Directorate for Materiel Management
Associate Director for Requirements & Resources, DRCMM-RS

PROJECT OFFICER:
Arthur Hutchison

INITIATION/COMPLETION DATES:
July 1977/November 1980.

ABSTRACT: Since 1977, the Army's Repair Cycle Times (RCT) have been challenged by OSD as being excessive. No effective programs existed for identifying and managing the items with costly repair cycle times.

The second shortcoming of the Secondary Item repair program was the inability of the MSCs to routinely identify items in short supply and pass the appropriate priority of repair to the depot.

MAJOR CONCLUSIONS/RECOMMENDATIONS:
The major problem found was the failure of the management and ADP systems at the MSCs, at DESCOM and at the Depots to mesh properly. As a result, repair programs were often initiated and managed without adequate planning and control. Moreover, there was no effective routine system for assuring that Depots repaired items that were most needed. Two major system developments were initiated as follows:

a. A Selective Management program was developed to reduce RCTs on selected high dollar repair programs. An ADP product was designed which ranks reparable items in a buy position by the dollar value of the Repair Cycle Times. Procedures were also designed for the MSCs, DESCOM and Depots to systematize the advanced planning of repair items and for the close surveillance of repair while in progress to assure that Repair Cycle Times were kept as short as possible.

b. A reparable item priority scheme was developed which assigns an urgency of need rank to items in the repair program based on their asset position, unserviceable on hand, and expected demand through the Repair Cycle Time. An ADP product was developed and run at several MSCs which identifies items in a backorder status with unserviceables on hand. This is the highest priority situation.

IRO Project 255 (cont)

IMPLEMENTATION STATUS:

a. The Selective Management program and ADP routines have been implemented by DARCOM.

b. The prioritization procedures were accepted by DARCOM but complete implementation has been delayed until re-design by ALMSA of the Requirements Distribution and Execution System.

RELATED STUDIES:

"Requirements-Drive Repair Scheduling System for Secondary Items," Arthur Hutchison, IRO Final Report, September 1977 (AD A046579).

US ARMY INVENTORY RESEARCH OFFICE
COMPLETED STUDY SUMMARY

TITLE: ORF/ERPSL Tradeoffs

IDENTIFICATION NUMBER:
IRO Project No. 276

REPORT: "Investigation of ORF/ERPSL Tradeoffs," Alan J. Kaplan, IRO Technical Report, August 1981, AD106006.

SPONSOR: DARCOM Directorate for Materiel Management
Associate Director for Maintenance, DRCMM-M

PROJECT OFFICER:
Alan J. Kaplan

INITIATION/COMPLETION DATES:
April 1979/September 1981

ABSTRACT: A model was developed of the interaction between stockage of float end items, stock of essential repair parts/spares, and operational availability. The model was applied to a missile system to find the least cost mix of float and spare/repair parts to achieve a target operational availability. Sensitivity analysis was done.

MAJOR CONCLUSIONS/RECOMMENDATIONS:
The concepts developed must be employed on a case by case basis. The only general conclusion which can be made is that end item float and ERPSL (Essential Repair Part Stockage List) should not be considered independent of each other.

IMPLEMENTATION STATUS:
There are no immediate plans for general implementation. Concepts will be used to supplement inventory/maintenance tradeoff model now being developed so that end item float may be considered.

RELATED STUDIES:

1. IRO Project 260, Operational Readiness Oriented Logistics Support Models (IRO study in progress).

2. "Study of Army Maintenance Float Policies and Management Practices," Edwin Gotwals, Larry Smith, W. Karl Kruse, John Fortune, IRO Final Report, September 1977 (AD A048270).

3. IRO Project 287, Supply/Maintenance Trade-Off Analysis (IRO study in progress).

US ARMY INVENTORY RESEARCH OFFICE
COMPLETED STUDY SUMMARY

TITLE: Management of Wholesale Stocks by Weapon System

IDENTIFICATION NUMBER:
IRO Project No. 277

REPORT: "Weapon System Supply Performance Analyzer," W. Karl Kruse, Technical Report, July 1981, AD A103890.

SPONSOR: US Army Communications & Electronics Readiness Command
Directorate of Materiel Management, DRSEL-MMO-S2

PROJECT OFFICER:
W. Karl Kruse

INITIATION/COMPLETION DATES:
July 1979/June 1981

ABSTRACT: This study developed a new management tool for the Major Subordinate Commands (MSC) referred to as the Weapon System Supply Performance Analyzer (SPA). It enables the MSCs to set their safety levels by weapon system grouping within the guidelines of DoDI 4140.39. The SPA makes estimates of supply performance (stock availability and customer waiting time) as a function of costs (commitment authority and safety level investment). An inter-active ADP program was provided that can be run conveniently from a terminal.

MAJOR CONCLUSIONS/RECOMMENDATIONS:
Preparation and execution of repair parts budgets by Weapon System or Weapon System grouping is feasible when the Weapon System SPA is used. Recommendations were made to DARCOM that this be tried on a selective basis.

IMPLEMENTATION STATUS:
Although the MSCs are beginning to accept the SPA concept, IRO is running the programs on data provided by the MSCs. There is an effort underway at MICOM to adapt the computer programs to the IBM machines used by the CCSS. Other MSCs continue to use the programs on an experimental basis. DARCOM has not yet decided to implement the concept.

RELATED STUDIES:
"Supply Performance Analyzer," W. Karl Kruse, IRO Final Report, June 1976 (AD A029711).

US ARMY INVENTORY RESEARCH OFFICE
COMPLETED STUDY SUMMARY

TITLE: CCSS Go-To-War (Supply Management)

IDENTIFICATION NUMBER:
IRO Project No. 280

REPORT: "CCSS Go-To-War (Supply Management)," Bernard B. Rosenman, IRO Final Report, November 1980 (AD-A092723)

SPONSOR: DARCOM Directorate for Materiel Management
Associate Director for Requirements & Resources, DRCMM-RS

PROJECT OFFICER:
Bernard B. Rosenman

INITIATION/COMPLETION DATES:
October 1979/November 1980

ABSTRACT: Concern exists about the ability of CCSS to respond to a surge in activity and sustain operations at a satisfactory level when a war emergency occurs. In the Supply Management area, it is recognized that certain applications must immediately switch over to a wartime mode of operation and others must be scaled down, deferred or eliminated entirely in order to allow both the ADP equipment and personnel to cope with wartime conditions. This study was undertaken to develop a set of recommendations for such a situation.

MAJOR CONCLUSIONS/RECOMMENDATIONS:
One set of recommendations was made covering the switchover from peacetime to wartime demand forecasting and other supply management procedures and the modification of supply management decision parameters to regulate the ADP and manual workload under wartime conditions. A second set of recommendations was made on CCSS applications that could be eliminated during wartime and those that could be deferred during an initial surge period.

IMPLEMENTATION STATUS:
Decision on implementation priority within CCSS to be determined by DARCOM Mobilization Automation Work Group.

RELATED STUDIES:
DARCOM Mobilization Automation Work Group

US ARMY INVENTORY RESEARCH OFFICE
COMPLETED STUDY SUMMARY

TITLE: Treatment of Serviceable Returns in Supply Control Studies

IDENTIFICATION NUMBER:
IRO Project No. 284

REPORT: "Treatment of Serviceable Returns in Supply Control Studies," Sally Frazza, IRO Final Report, August 1981 (AD A105440).

SPONSOR: DARCOM Directorate for Materiel Management
Associate Director for Requirements & Resources, DRCMM-RS

PROJECT OFFICER:
Sally Frazza

INITIATION/COMPLETION DATES:
August 1980/August 1981

ABSTRACT: The problem addressed is determining the optimal treatment of serviceable returns in computing repair parts requirements. Because the forecast of serviceable returns is not trusted, their use as an offset to the demand forecast is limited by the MSCs to a maximum percent of the total demand. Lack of a standard method of treatment led to criticism by the GAO.

Empirical work with a forecast evaluator shows an imperceptible difference in cost/performance when serviceable returns are used to offset the demand forecast. This result holds regardless of the limit set on the percentage of demand forecast which can be offset by returns.

MAJOR CONCLUSIONS/RECOMMENDATIONS:
Using returns to offset demand history does not significantly improve the forecast of future net demands. A forecast which offsets returns will cost less, but will also result in a lower supply performance. Our findings show that adjusting the demand forecast by returns has the same effect as not offsetting the demands with returns but lowering the performance goal. In either case, the change in cost and the change in supply performance are virtually identical.

IMPLEMENTATION STATUS:
As a result of this study, a DARCOM letter prescribes that any Command using a serviceable return percent greater than 20 percent must furnish rationale to DARCOM (DRCMM-RS).

RELATED STUDIES:
None.

US ARMY INVENTORY RESEARCH OFFICE
COMPLETED STUDY SUMMARY

TITLE: Supply Control Study Instability

IDENTIFICATION NUMBER:
IRO Project No. 285

REPORT: "Supply Control Study Instability," Bernard B. Rosenman, IRO Final Report, June 1981 (AD A103895).

SPONSOR: DARCOM Directorate for Materiel Management
Associate Director for Requirements & Resources, DRCMM-RS

PROJECT OFFICER:
Bernard B. Rosenman

INITIATION/COMPLETION DATES:
August 1980/June 1981

ABSTRACT: Many items experience changes in recommended action from one supply control study to the next--Buy to Cutback, Cutback to Buy, Buy to Excess, etc. These "flip-flops" cause turbulence in supply management and supporting activities such as procurement and depot rebuild. Little is known about what causes these conditions and how to correct them.

MAJOR CONCLUSIONS/RECOMMENDATIONS:
Most of the instability is due to difficulties encountered in entering and maintaining programmed and non-recurring requirements in the Requirements Sector of the CCSS NSN Master Data Record. This is largely a manual process and highly subject to human error. Sudden and large changes in Administrative and Production Lead Times, owing to the practice of using the last observation as a forecast, were also found to be a major contributor to instability. Other causes included Due In/Due Out file maintenance, also largely a manual process, and difficulties experienced in maintaining "Buy Ahead" procurement quantities in the requirements stack. Some minor CCSS system errors were also found.

IMPLEMENTATION STATUS:
Problems due to use of the last representative buy as a forecast for the next ALT/PLT have been known for some time. Use of a moving average for ALT has recently been implemented but not for PLT. It is on ALMSA's waiting list of System Change Requests (SCRs), as are the SCRs submitted to correct programming errors found in this study.

No implementation actions are pending on problems due to human error. These arise from complexity of procedures, inadequacy of analyst training and workload pressures. What is to be investigated in the future is whether or not the complex procedures

IRO Project 285 (cont)

that have to be followed to generate and maintain programmed demand forecasts result in forecast accuracy improvements commensurate with the effort required.

RELATED STUDIES:

None.

US ARMY INVENTORY RESEARCH OFFICE
COMPLETED STUDY SUMMARY

TITLE: Analysis of CCSS Transactions Requiring Off-Line Processing

IDENTIFICATION NUMBER:
IRO Project No. 288

REPORT: None

SPONSOR: DARCOM Directorate for Materiel Management
Associate Director for Supply and Distribution, DRCMM-S

PROJECT OFFICER:
Alan J. Kaplan/Arthur Hutchison

ABSTRACT: A significant number of CCSS transactions (requisitions, receipts, etc.) are rejected according to various edit criteria and must be processed manually. This results in heavy use of manpower and processing delay. One possible improvement under consideration was to speed up processing and reduce workload through use of minicomputers with on-line interactive edit.

MAJOR CONCLUSIONS/RECOMMENDATIONS:
Re-entry times for rejected transactions are a function of the individual MSC's procedures and emphasis in this area. Some Commands are able to process quickly with current equipment.

Individual Commands are at work on proposals for reducing rejects and converting some of the manual rejects to rejects with automated response.

IMPLEMENTATION STATUS:
No specific recommendations for DARCOM action were formulated. Some of the best Command procedures/ideas were documented in a series of trip reports, with a view to their use by the others.

RELATED STUDIES:
None.

US ARMY INVENTORY RESEARCH OFFICE
ONGOING STUDY SUMMARY

TITLE: War Reserve Requirements for New Weapon Systems

IDENTIFICATION NUMBER:
IRO Project No. 258

SPONSOR: DARCOM Directorate for Supply, Maintenance and Transportation, DRCSM-PPW

PROJECT OFFICER:
Donald A. Orr/Bernard B. Rosenman

INITIATION/PROGRAMMED COMPLETION DATES:
September 1977/November 1981

PROBLEM: Heretofore War Reserve requirements have not been developed for new weapon systems until they have actually been deployed. It is desired, however, to estimate what these requirements will be for budgetary purposes far in advance of that time.

OBJECTIVES:

To develop a procedure for estimating War Reserve budgetary requirements for new weapon systems that are scheduled for deployment in the POM/FYDP period. The procedure must be capable of use during early phases of weapon system development when data on expected failure rates, maintenance support planning, etc., are only partially available.

CURRENT STATUS:

The Bare Bones Standard Initial Provisioning (BBSIP) Model, previously developed by IRO, was adapted for use for War Reserve computations. This new model, the Bare Bones War Reserve Model, was tried out on six new weapon systems by estimating their funding requirements for 1980-84 POM. Briefings on the procedure and results of the computations were given at DARCOM, DA and DoD, resulting in approval of its use as a standard procedure, and it has been used for POM submissions since FY79.

This project was not closed out because of a desire to supersede BBWARRSV by WAR version of SESAME. (SESAME is the refined all purpose provisioning computational model.) This "SESAME-4-WAR" will run many components and several scenarios at a time and hence alleviate much of the manual workload which is associated with BBWARRSV program runs in completing the required format of the budget tableau.

The design and distribution of SESAME-4-WAR has been put under the aegis of the Provisioning Technical Working Group. IRO has provided the specs and final program. Distribution of the final version of the program was made in November 1981. DARCOM decision on how User's Guide will be be promulgated is being awaited.

IRO Project No. 258 (cont)

RELATED STUDIES:

"Bare Bones: A Method for Estimating Provisioning Budget Requirements in the Out-Years," Donald A. Orr, IRO Final Report, July 1977, (AD A044508).

US ARMY INVENTORY RESEARCH OFFICE
ONGOING STUDY SUMMARY

TITLE: Forecasting Methods for Parts Support of Depot Overhaul

IDENTIFICATION NUMBER:
IRO Project No. 259

SPONSOR: DARCOM Directorate for Supply, Maintenance and Transportation, DRCSM-WRS

PROJECT OFFICER:
W. Karl Kruse/Edwin Gotwals

INITIATION/PROGRAMMED COMPLETION DATES:
January 1981/March 1982

PROBLEM: The Parts Explosion (PE) process at the MSCs produces forecasts of the parts needed to support overhaul programs. Despite several attempts to correct the deficiencies of this process, the MSCs remain dissatisfied with the parts forecasts. One MSC has stopped using PE altogether, while several others have devised computer bridges and manual procedures designed to improve the products of PE.

OBJECTIVES:
Identify the problems associated with PE and recommend corrective actions.

CURRENT STATUS:
Although the complaints have been about the PE process, the problems which appear in the output of PE are caused by problems in the Maintenance Overhaul Factor Reporting System (MOFARS) and the Overhaul Consumption Data (OCD) processes. MOFARS is a system by which the depots and MSC's coordinate their planning data. The OCD file is the MSC's repository for overhaul factors and is updated primarily by MOFARS.

For the most part, the MSCs' complaints relate to the incompleteness of the OCD file. At the overhaul depot it is a simple matter to update the Mortality Data File (MORT) which is the depots repository for overhaul factors. However, the system at the MSC requires that the OCD always be compatible with the NSNMDR. Various checks make it unnecessarily difficult for the MSCs to update the OCD based on consumption experience.

A recommendation of this study is to expand the capability of the overhaul depot forecasting system so that long term forecasts can be produced there which are suitable for use by the MSCs for timely procurement of parts. We are now awaiting comments from the MSCs on this proposal after which DESCOM reaction will be sought. If given the go-ahead, we will develop the necessary system guidance for ALMSA and LSSA. In addition it will be necessary to change

IRO Project No. 259 (cont)

the procedures for forecasting parts support for contracted overhaul. We have not yet investigated this area.

RELATED STUDIES:

"Overhaul Factor Forecasting," Peter Fatianow, IRO Final Report, May 1975.

US ARMY INVENTORY RESEARCH OFFICE
ONGOING STUDY SUMMARY

TITLE: Operational Readiness Oriented Logistics Support Models

IDENTIFICATION NUMBER:
IRO Project No. 260

SPONSOR: DARCOM Directorate for Supply, Maintenance and Transportation, DRCSM-WRS/PMP

PROJECT OFFICER:
Alan J. Kaplan/Martin Cohen/Meyer Kotkin

INITIATION/PROGRAMMED COMPLETION DATES:
October 1977/September 1982

PROBLEM: Multi-echelon inventory models allow the achievement of system operational availability goals at least cost. A number of models exist in the literature, but none was fully satisfactory for Army use.

OBJECTIVES:
Promote use and implementation of improved multi-echelon models.

CURRENT STATUS:
A computer program (SESAME) has been developed and distributed to DARCOM users. The program has been designed to fit the available data and computing resources of the potential users. The DARCOM Provisioning Models Technical Working Group, to which IRO provides continuing technical support and direction, has recommended changes that are currently being implemented. These changes reflect user inputs and needs as more experience is gained with SESAME.

SESAME, for computational reasons, currently assumes a symmetric system in which all support activities within a given support level (DSUs, for example) are assumed to be identical. In reality this assumption is hardly ever true. The effects of making this assumption are currently being investigated. Preliminary results were presented at the Multi-Echelon Inventory Conference held in Washington, DC, 20-21 June 1981. A full scale test of a heuristic to use SESAME results in an asymmetric system is being conducted on AAH helicopter data supplied by TSARCOM.

As it will be sometime before all Army items are under multi-echelon management, work has begun on how to coordinate the use of single echelon models in a multi-echelon system. A technical report is in preparation.

Other work is also in process on adaptation of SESAME type models for use in a non-stationary (dynamic) environment.

RELATED STUDIES:
1. SESAME User's Guide, DARCOM Pamphlet 700-18.

IRO Project No. 260 (cont)

2. "Mathematics of the SESAME Model," Alan Kaplan, IRO Technical Report, February 1980.

3. "Estimating System Availability with Redundancy Spares and Installation Times," Alan Kaplan, IRO Technical Report, March 1981.

4. "An Exact N-Echelon Inventory Model: The Simple Simon Method," W. Karl Kruse, IRO Technical Report, March 1979.

5. "A Heuristic In Multi-Echelon Multi-Indentured Inventory Problems," Meyer Kotkin, IRO Technical Report, December 1978.

6. "On the Optimal Stock Levels in Multi-Echelon Maintenance Systems," Meyer Kotkin, IRO Technical Report, June 1978.

US ARMY INVENTORY RESEARCH OFFICE
ONGOING STUDY SUMMARY

TITLE: RIMSTOP Implementation

IDENTIFICATION NUMBER:
IRO Project No. 261

SPONSOR: Deputy Chief of Staff for Logistics, Army
Assistant Director for Supply Management, DALO-SMP-U

PROJECT OFFICER:
Arthur Hutchison/Robert L. Deemer

INITIATION/PROGRAMMED COMPLETION DATES:
May 1978/February 1982

PROBLEM: As a result of work done by a study group under its auspices, DoD issued DoD Directive 4140.44 and DoD Instructions 4140.45 and .46 containing policies for the management of consumable and reparable secondary items at the consumer and intermediate levels of field supply. It is required that all DoD components implement these policies, which include the requirement for use of inventory models that are far more advanced than those now in use. There are a number of technical and human-computer interface problems that must be overcome in order for implementation to be done successfully.

OBJECTIVES:

Evaluate the Army's procedures for implementing the consumable RIMSTOP model at the retail level. Determine the need to modify this model to consider operational constraints such as mobility, workload and ADP run times.

Develop a standard ADP program to compute requisition shortage costs (λ) for use by the Installation Supply Accounts, SAILS, and DS4.

CURRENT STATUS:

Simulation runs were made comparing the fixed safety level model and RIMSTOP. Results indicate that the RIMSTOP model outperforms the current Army's stockage model when comparing stock availability per inventory investment dollar. The breadth of stock is increased using RIMSTOP but the overall stockage depth is significantly reduced for a baseline availability target.

It was also shown that inventory weight and cube will not increase with the implementation of RIMSTOP. Therefore no immediate plans exist to modify the RIMSTOP model to include weight and cube constraints.

The final report on the simulator has been written and is being reviewed prior to distribution.

IRO Project No. 261 (cont)

The program to generate the requisition short cost ($) for SAILS was written and implemented at the Ft. Carson test site in September 1981. Preliminary figures indicate a 25% increase in lines stocked but no change in inventory investment dollars needed to achieve higher supply performance targets. Shortage costs have also been computed for all other SAILS sites scheduled to convert to RIMSTOP in January 1982.

Programs to generate the λ values for ISA and DS4 operations have been written and forwarded to the LSSA and the Army Logistics Center for incorporation into their standard systems. RIMSTOP and the LAMBDA program should be operational in early calendar year 1982.

RELATED STUDIES:

1. "Calculation of Percent Error Tables for Use in the RIMSTOP Implementation," Arthur Hutchison, IRO Technical Report, September 1980 (AD A090141).

2. "Evaluation of Several Forecasting Techniques for Retail Level Stockage," Arthur Hutchison, IRO Technical Report, September 1980 (AD A090104).

US ARMY INVENTORY RESEARCH OFFICE
ONGOING STUDY SUMMARY

TITLE: Evaluation of Provisioning Procedures

IDENTIFICATION NUMBER:
IRO Project No. 265

SPONSOR: DARCOM Directorate for Supply, Maintenance and Transportation, DRCSM-PM

PROJECT OFFICER:
Donald A. Orr

INITIATION/PROGRAMMED COMPLETION DATES:
May 1979/September 1982

PROBLEM: Many Army proponents feel initial support requirements (Spare & Repair Parts), when determined in accordance with DoDI 4140.42 policies, are inadequate to support newly fielded systems at their required operational availability. To bolster or belie this intuition, evaluations of provisioned quantities based on field performance are needed. Although Army policy requires such evaluations (Post Provisioning Review) 360 days after initial deployment of the end item, such analyses have been barely extant at best. A main (but not the only) reason for the dearth of reviews has been a lack of a paradigm and consequent systematic procedures for collecting and analyzing data in a reasonable, feasible manner.

With the advent of SIP and the sophisticated SESAME program, it is feasible to compute part quantities in accordance with .42 or with some cost effective optimal technique. These programs, suitably adjusted, can also evaluate the impact of these support quantities and other possibly realized quantities in terms of system availability. Another potentially solvable problem via the program is to assess the impact on quantities and operational readiness when the actual provisioning parameter set (experienced field values of repair times, task distributions, washout and failure rates) differs from the original parameter set used to ascertain initial issue.

OBJECTIVES:

Phase 1 - Design an evaluative system for detail comparisons of theoretical, hypothetical, and actual provisioning quantities and subsequent operational readiness values. Consider computed SIP, ERPSL models' quantities and real life adjustment thereof. Use the above evaluator on data obtained from pilot tests on selected end items and identify any shortcomings in DoDI 4140.42 procedures.

CURRENT STATUS:

This project has become one phase of an expanded provisioning study taken over by AMSAA. This expanded project is planning to study the budgeting process, general problems in provisioning and fielded systems that are similar to those currently being provisioned. IRO

IRC Project No. 265 (cont)

is working with MSCs and Project Manager Offices on sample data collection plans and evaluative schemes for the M1 tank, and perhaps one or two other new systems. Data on the M1 tank will be collected by PECO enterprises and stored and retrieved thru the INFONET system.

RELATED STUDIES:

"Provisioning Methodology Validation Assessment Study," AMSAA Project No. 81-5A.

US ARMY INVENTORY RESEARCH OFFICE
ONGOING STUDY SUMMARY

TITLE: Updating Failure Factors

IDENTIFICATION NUMBER:
IRO Project No. 275

SPONSOR: DARCOM Directorate for Supply, Maintenance and Transportation, DRCSM-PM

PROJECT OFFICER:
Donald A. Orr

INITIATION/PROGRAMMED COMPLETION DATES:
April 1979/March 1982

PROBLEM: Engineering estimates of failure factors (replacement rates of components) often do not reflect actual experience once the end item is fielded. Updating of these estimates is particularly needed for the later provisioning requirements of long-term procurement and deployment programs (including FMS).

OBJECTIVES:
Develop an automated method of combining initial failure factors with experienced replacement rates for parts in fielded systems.

CURRENT STATUS:
A strawman package of working papers has been developed to define factors, describe scenarios, code and store scenario information and factors, and to update the various factors using inference techniques on experienced wholesale or retail demand data.

Meetings have been held to uncover implementation problems and make recommendations on redesign of pertinent files. Which items can be candidates and which of a number of alternative updating schemes would be most practicable, for updating automatically in an initial implementation, are questions that are considered.

MICOM has agreed to incorporate the IRO algorithm (a special case of which is their local update procedure) in bridging programs which access CCSS files. It is intended to give this FORTRAN-COBOL program to the other Commands to use for automated updating.

RELATED STUDIES:
"New Concepts for Provisioning Parameter Estimates, Part I," Donald A. Orr, IRO Technical Report, December 1976 (AD A034589).

US ARMY INVENTORY RESEARCH OFFICE
ONGOING STUDY SUMMARY

TITLE: Supply Performance Indicators

IDENTIFICATION NUMBER:
IRO Project No. 278

SPONSOR: DARCOM Directorate for Supply, Maintenance and Transportation, DRCSM-MRS

PROJECT OFFICER:
Edwin Gotwals

INITIATION/PROGRAMMED COMPLETION DATES:
October 1979/February 1983

PROBLEM: Presently there are no statistics collected on a routine basis that can give early warning of changes in conditions which might degrade stock availability. Based on findings from the IRO Project 267 "Stock Availability Improvement," it is felt that by monitoring the errors made when estimating key input parameters to the supply control studies, trouble areas can be spotted in time to do something about them.

OBJECTIVES:
To identify the model parameters in CCSS whose forecast error most affect supply performance and to develop a method to monitor these errors.

CURRENT STATUS:
Work was done with TACOM to define conceptual approaches. TDY fund shortage and long term illness of the project officer caused project to be suspended. Work has recently been resumed. Data collection specifications are being developed, from which TACOM will write computer program to extract data from CCSS files for analysis.

RELATED STUDIES:
IRO Stock Availability Improvement Briefing, April 1978, (IRO Project 267).

US ARMY INVENTORY RESEARCH OFFICE
ONGOING STUDY SUMMARY

TITLE: Financial Management of the Army Industrial Fund

IDENTIFICATION NUMBER:
IRO Project No. 279

SPONSOR: DARCOM Office of the Comptroller, Finance and Accounting Division, Property and Cost Policy Branch, DRCCP-FW

PROJECT OFFICER:
Alan J. Kaplan

INITIATION/PROGRAMMED COMPLETION DATES:
October 1979/March 1982

PROBLEM: DARCOM finds it difficult to justify requests for additional cash from higher headquarters, or to determine whether returns of cash from revolving funds may be made.

OBJECTIVES:
Develop a cash flow model which will objectively project future cash requirements in a timely manner.

CURRENT STATUS:
Project was initially undertaken for the Army Stock Fund. It was shortly decided by the sponsor, however, that work on the problem within the AIF was more urgent.

A computerized cash model was developed and tested first for DARCOM depot activities and DESCOM. As a final test it was run by DESCOM personnel on a pilot basis. The model was then generalized for use at other AIF activities.

Final report is being written. It is sponsor's intention to achieve full implementation before the end of FY82.

RELATED STUDIES:
None.

US ARMY INVENTORY RESEARCH OFFICE
ONGOING STUDY SUMMARY

TITLE: War Reserve ADP System Project

IDENTIFICATION NUMBER:
IRO Project No. 281

SPONSOR: DARCOM Directorate for Supply, Maintenance and Transportation, DRCSM-PPW

PROJECT OFFICER:
Steven Gajdalo

INITIATION/PROGRAMMED COMPLETION DATES:
April 1980/December 1982

PROBLEM: Computations of war reserves, TLR/S, and LOGPLANS at the Materiel Readiness Commands are only partially automated and are not standardized. Under this arrangement it is difficult to justify/audit computed requirements and to respond to "what if" questions from DA and DoD. A new regulation (DoDI 4140.47) has directed that all sources have a common baseline for war reserve computations, necessitating major changes in current DARCOM approaches to computations.

OBJECTIVES:

Develop a standard automated capability to compute requirements and produce output products for the full range of war reserve and mobilization planning actions (i.e., General Mob/AR 11-11, TLR/S, LOGPLANS). These applications are to be in consonance with the DoDI 4140.47 and with other DoD and DA guidance.

CURRENT STATUS:

A concept study for computing War Reserves has been completed by AMSAA and a modified IRO/AMSAA concept on approaches to be followed has been approved by DARCOM Headquarters and DA. A functional document has been completed and is currently being staffed. Implementation has been scheduled for CCSS Release 67 (May 1984).

FY82 effort will be on development of functional specifications for TLRS/LOGPLANS and consulting in the system design area.

RELATED STUDIES:

1. "Updating Failure Factors," IRO Project No. 275 (On-going).

2. "Provisioning Master Record Redesign," current effort of the PMR Work Group.

3. "War Reserve Requirements for New Weapon Systems," IRO Project 258 (current effort).

IRO Project No. 281 (cont)

4. "Operational Readiness Oriented Logistic Support Models," IRO Project 260 (ongoing).

5. "RIMSTOP Implementation," IRO Project 261 (ongoing).

6. "Combat PLL/ASL Methodology," IRO Project 283 (ongoing).

US ARMY INVENTORY RESEARCH OFFICE
ONGOING STUDY SUMMARY

TITLE: Combat PLL/ASL Methodology

IDENTIFICATION NUMBER:
IRO Project No. 283

SPONSOR: DARCOM Directorate for Supply, Maintenance and Transportation, DRCSM-PM

PROJECT OFFICER:
Bernard B. Rosenman/Martin Cohen

INITIATION/PROGRAMMED COMPLETION DATES:
March 1980/September 1982

PROBLEM: This is the IRO portion of DA-sponsored work to develop stockage lists for Organizational and Direct Support Units. The lists are to contain the parts needed for combat operations.

OBJECTIVES:
Develop an automated method of producing least-cost stockage lists that will meet operational availability targets for essential end items without hampering mobility. IRO's responsibility is the development and test of appropriate models and computational procedures and preparation and evaluation of initial lists. It is expected that MRSA will take over production of Combat PLLs/ASLs once the models and procedures are deemed to be operating satisfactorily.

CURRENT STATUS:
Mandatory Parts List (Recommended Organizational Stockage) methodology has been developed and automated lists have been published for 22 TOEs. Present work involves development of models for computation of the supporting ASLs, development of models for combining wearout and combat damage failures, and participation in USAREUR program for evaluation of list effectiveness. This work is being carried on in conjunction with AMSAA, MRSA, MSCs, Army Logistics Center and TRADOC activities.

RELATED STUDIES:
None.

US ARMY INVENTORY RESEARCH OFFICE
ONGOING STUDY SUMMARY

TITLE: Treatment of Item Essentiality in CCSS

IDENTIFICATION NUMBER:
IRO Project No. 286

SPONSOR: DARCOM Directorate for Supply, Maintenance and Transportation, DRCSM-WRS

INITIATION/PROGRAMMED COMPLETION DATES:
June 1981/June 1982

PROBLEM: Since implementation of DoDI 4140.39 within the Army, the MSCs have been uncomfortable with the low safety levels (SL) produced by the CCSS for higher cost, low demand items.

Although an item essentiality weighting factor can be applied in the computations, the model has been implemented without this feature. Consequently, the model tends to produce SLs which are quite sensitive to the annual dollar value of demand.

OBJECTIVES:

The original objective of this project was to develop an item essentiality weight for each item to be used in the SL calculation. However, recent research at IRO in multi-echelon inventory models has caused us to re-think the study objective. There is now reason to question the basic formulation of the DoDI 4140.39 model itself. The model of the DoDI views the wholesale system in isolation from the rest of the supply system. When the wholesale level is viewed as the top level in a simple two-echelon system, it is found that the optimal wholesale stockage is not nearly as sensitive to dollar value as the DoDI 4140.39 policies stipulate they should be. Since this is a fundamental problem which cannot be corrected with essentiality weights, we have redefined the objective of the study so as to consider the wholesale stockage policies in a multi-echelon context.

CURRENT STATUS:

After discussion of our finding with OSD and the other Services, we are developing a more general multi-echelon supply model to evaluate wholesale policies.

RELATED STUDIES:

None.

US ARMY INVENTORY RESEARCH OFFICE
ONGOING STUDY SUMMARY

TITLE: Supply/Maintenance Trade-Off Analysis

IDENTIFICATION NUMBER:
IRO Project No. 287

SPONSOR: US Army Communications-Electronics Command, DRSEL-PL-SA

PROJECT OFFICER:
Donald Orr/Alan Kaplan

INITIATION/PROGRAMMED COMPLETION DATES:
November 1980/March 1982

PROBLEM: In developing a logistical support concept for a weapon system to be deployed, supply and maintenance decisions are made that impact the life cycle cost of the end item in question. In order to make the most of the Army's investment in dollars and manpower, optimization of the process that leads to initial commitments of stockage, repairmen, test equipment, and transport over several echelons of support is highly desirable.

Currently existing maintenance support or life cycle cost models used by the Army that make repair level and stockage decisions for the user, do not truly optimize by considering the tradeoffs and interactions amongst the repair, supply and transport processes. There is a need to marry an initial supply support program which makes multi-echelon stockage decisions in a cost-effective manner with an efficient algorithm for allocating repair and test equipment and skilled personnel to the various repair echelons.

OBJECTIVES:

1. Develops a hands-on computer program for making stockage and repair decisions in a multi-echelon environment.

2. Program will operate with input sets similar to SESAME and GEMM models in order to give the user guidance on where to repair, what to repair, where to place test equipment, skilled personnel and stockage and at what expense and performance.

3. Program will accept user specified constraints on what are desirable solutions.

4. Program will be "portable"; i.e. it will be easy to adapt for use on a variety of computers.

5. Current state of the art techniques will be applied to quickly develop a product which is significantly better than current computer packages. Subjects for future research and refinement will be identified and treated in a follow-on effort.

IRO Project 287 (cont)

CURRENT STATUS:

Several IPR's have been held with sponsor. IRO has developed the specs for a mixed integer program that, in conjunction with SESAME, which produces stockage costs, and a preprocessor, which produces Test Equip/MOS and transportation costs, determines optimal task distribution and placement of TE/MOS. Data requirements for the preprocessor have been furnished to CECOM systems analysis group for their programming.

The programming of OATMEAL (the integer LP), its interface with the other programs, and heuristics to shorten the run time (which may be a limiting factor) are tasks currently being faced by IRO.

RELATED STUDIES:

AMSAA study - M109 General Test Equipment Requirements Analysis (in progress).

US ARMY INVENTORY RESEARCH OFFICE

LOGISTICS MANAGEMENT ASSISTANCE

In addition to its formal work program, the IRO provides assistance upon request to DARCOM Headquarters and its Commands, and to other DA and DoD activities. This assistance involves work of a short term nature, generally requiring no more than a few man-months of effort. Some of the tasks worked on in FY1980 are described below.

CCSS Functional Coordinating Groups - IRO continues to provide representation on the FCG's for Supply Management, Maintenance Management, Provisioning, War Reserves and Mobilization. This involves attendance at meetings where System Change Requests are evaluated and doing short term studies on problems of immediate interest to the Groups. Attendance at the DARCOM Logistics Systems Review Committee meetings is also involved, where review of IRO projects is sometimes on the agenda.

Mobilization Automation Work Group (MAWG) - IRO is a member of this Group which is examining a variety of problems associated with ability of DARCOM automated systems to respond to mobilization surges. Certain IRO studies (CCSS Go-to-War, EAA Codes) were undertaken as result of problem areas identified by the MAWG.

End Article Application (EAA) Codes - IRO provided representation on a DARCOM Working Group that was tasked to solve the problem of non-standard EAAs: should they be standardized or could other approaches provide a way around non-standard EAA problems without requiring the enormous workload involved in having the MSCs convert to standard codes. An alternative solution proposed by the IRO involving use of a "dictionary" file was adopted by the Group and approved for implementation.

DARCOM Secondary Item Budget Support - Analyses of Command requirements data were done by IRO to determine revised Shortage Cost parameter values to be used in assessment of budgetary and supply performance impacts of incorporating lead time variance and in lifting certain safety level constraints in the CCSS requirements studies. These analyses provided justification for implementing these improvements in the CCSS Variable Safety Level/Economic Order Quantity module.

Maintenance Manpower and Logistics Analyses (MALA) - Assistance was provided to DARCOM Headquarters in evaluating analyses of M1 Tank sustainability done under Army Logistics Center auspices. The IRO SESAME model was used in part of this work.

OSD Supply Management Studies - IRO took part in several meetings with OSD, Service and DLA personnel on changes need to DoDI 4140.39, "Procurement Cycles and Safety Levels of Supply for Secondary Items." A representative was furnished for the Selection Board named to select a contractor to do a study for OSD on demand forecasting techniques. Assistance was later given to the selected contractor in their literature search and in providing detailed information on previous IRO work in this field.

Miscellaneous - Other short term assistance was provided as follows:

To -

Picatinny Arsenal, on evaluation of a spares model proposed for use by a contractor for Life Cycle Cost analyses on the DIVAD gun.

ARRADCOM, on how to cost out logistics support in evaluating approaches to modification of the M16A1 Rifle to accommodate to the NATO round.

a Navy contractor, on approaches to determining improved aircraft carrier allowance lists.

National Park Service, in preparation of "how to" manuals on inventory management and maintenance practices; these are distributed to municipal, state and other park managers who request assistance from the Park Service in these areas.

US ARMY INVENTORY RESEARCH OFFICE

PROFESSIONAL ACTIVITIES

Papers published in technical journals, participation in meetings of professional societies and other professional activities are reported here:

Technical Papers

"Waiting Time in a Continuous Review (s,S) Inventory System with Constant Lead Times," W. Karl Kruse, Operations Research, Vol 29, No. 1, Jan-Feb 1981.

"A Note on Initial Fill Rate," Alan J. Kaplan, Canadian Journal of Operations Research and Information Processing (INFOR), Vol 19, No. 1, Feb 1981.

Papers Presented at Professional Meetings

Alan J. Kaplan and Sally Frazza, "Second Echelon Performance Targets," presented at Multi-Echelon Inventory Systems Conference, sponsored by Logistics Management Institute, 20-21 June 1981, Arlington, VA.

Meyer Kotkin, "Exploiting Symmetry in Multi-Echelon Inventory Systems," presented at Multi-Echelon Inventory Systems Conference, sponsored by Logistics Management Institute, 20-21 June 1981, Arlington, VA.

Bernard B. Rosenman, "Repair Parts Essentiality and Weapons Systems Sustainability," presented at 19th Army Operations Research Symposium, 14-17 Oct 1980, Ft. Lee, VA.

In addition, Edwin P. Gotwals, III, prepared a paper "Evaluation of Forecast Methods in an Inventory Management System (An Empirical Study)" for presentation at the Joint National CORS/ORSA/TIMS meeting, held 3-6 May 1981, in Toronto, Canada, but was unable to attend because of a shortage of travel funds. Also, Mr. Rosenman had arranged and was to chair a session "Logistics Support and Weapons Systems Sustainability," at the same meeting but could not attend for the same reason.

Other Professional Activities

Mr. Kaplan continued as a referee for INFOR and refereed one paper during the year.

Mr. Kruse is now a referee for Operations Research and Management Science and refereed one paper for each during the year.

Mr. Rosenman gave what seems to be his annual lecture in a graduate inventory Theory class at Cornell University.

US ARMY INVENTORY RESEARCH OFFICE

REPORTS

The following reports were published in the period October 1980 thru September 1981:

"Integrated Forecasting Techniques for Secondary Item Classes - Part I - Active Items," Edwin Gotwals, Donald Orr, Final Report, Sep 80, AD A097024.

"Integrated Forecasting Techniques for Secondary Item Classes - Part II - Inactive Items," Edwin Gotwals, Final Report, Sep 80, AD A097025.

"CCSS Go-to-War (Supply Management)," Bernard B. Rosenman, Final Report, Nov 80, AD A092723.

"Annual Report - Fiscal Year 1980," Dec 80, AD A094657.

"Two Methodologies for Combat Unit Stockage," Martin Cohen, Sally Frazza, Alan Kaplan, Larry LeBlanc, Technical Report, Feb 81, AD A096338.

"Secondary Item Repair of Depot Reparables," Arthur Hutchison, Final Report, AD A097185.

"Estimating Availability for Systems with Redundancy, Spares and Installation Times," Alan Kaplan, Technical Report, Mar 81, AD A099026.

"OSD Stockage Policy Analysis: A Summary," W. Karl Kruse, Final Report, May 1981, AD A100687.

"Supply Control Study Instability," Bernard B. Rosenman, Final Report, June 81, AD A103895.

"Weapon System Supply Performance Analyzer," W. Karl Kruse, Technical Report, July 81, AD A103896.

"Treatment of Serviceable Returns in Supply Control Studies," Sally Frazza, Final Report, Aug 81, AD A105480.

"Investigation of ORF/ERPSL Tradeoffs," Alan Kaplan, Technical Report, Aug 1981, AD A106006.

"Evaluation of Forecast Methods in an Inventory Management System - An Empirical Study," Edwin Gotwals, Technical Report, Aug 81, AD A107894.

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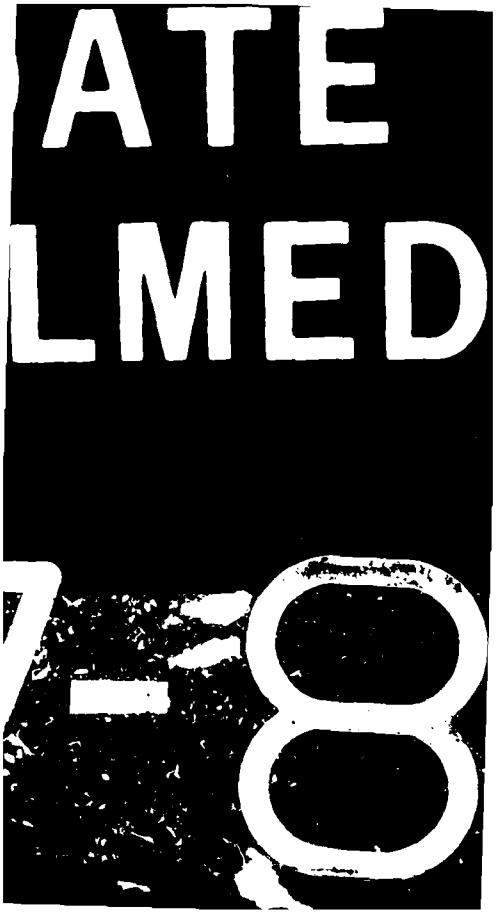
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